

3D-vision lab @ Open Labs Graz, an out-of-school learning environment

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Vision is an integral part of our everyday life. We are used to perceive our natural surroundings in three dimensions but thanks to 3D-technology, pictures which used to be 2D (photos, films) are available in 3D nowadays. So, the topic of 3D-images seems to be motivating for stimulating interest and science learning. At the Open Labs Graz ("Mitmachlabore Graz") of the University of Graz an extracurricular learning environment on 3D-images and vision is currently developed and implemented. The concept is tested with 10-11 grade students. Our poster presents experiments of the 3D-lab and key ideas they convey.

1 Starting point and motivation

In Austria, physics is still one of the least popular school subjects. According to international comparative studies like PISA, Austrian students achieve modest results in science and they show low motivation for science [1]. As far as motivation and interest are concerned, Austrian students show also the biggest gender-gap [2] of the PISA sample. Reasons identified are traditional ways of instruction, which do not integrate inquiry learning strategies, as well as decontextualized learning environments, which do not connect to everyday experiences.

In contrast to this, our everyday lives are determined by rapidly developing science and technology applications. 3D-technology is one topic which is currently revolutionizing entertainment as well as industry. Students are familiar with phenomena like virtual reality and augmented reality as well as with devices like 3D-printers and 3D-glasses for watching 3D-movies at cinemas or at home.

The context of 3D-vision seems to be appropriate to trigger learning processes on image formation and human vision. In addition, interest studies like ROSE show that biological contexts related to the human body are of high interest and equally appealing for male and female students [3]. Hence, both 3D-images and the process of 3D-vision are interesting and highly interdisciplinary topics for science education.

2 The 3D-lab environment

Aim of this project is the development of a learning environment focusing on 3D-vision which is implemented at the Open Labs Graz. The Open Labs Graz are out-of-school labs located at the University of Graz which offer high school students the opportunity of collecting science experiences in the fields of molecular biology, genetics, microbiology and physics at an authentic university environment. Learning is organized in science quests which follow an inquiry based approach, so the Open Labs are a decent place for students to gain experiences, which cannot be provided by conventional school environments [4].

The learning path of the 3D-lab starts with a revision of human vision and its conditions on a basic level. The students get the chance to reflect their prior knowledge of introductory physics classes. A major emphasis is put on the sender-receiver-model of vision, which explains the

perception of our surroundings based on the path of light evolving from a sender (primary or secondary light source) up to the human visual system (receiver).

Afterwards, this basic idea of vision is elaborated and 3D-vision is introduced. Students get a series of experimental tasks, which are the starting point for their inquiry processes on real and virtual image formation. Although the distinction of real and virtual images is a very basic concept of introductory optics, it is well known that many students fail to gain a solid understanding of virtual images [5].

The final part of the learning path focuses on 3D-images and vision. As a teaser Mirascopes are used. They generate 3D-images by two convex mirrors. Then students inquire different 3D-phenomena in hands-on tasks, which are based on a bring your own device approach [6].

3 Development and research

The concept for the 3D-lab is tested in a pilot study with intervention classes aged between 15 and 17. A first version of the learning environment is implemented and evaluated following the research paradigm of Design-Based Research [7]. Students' learning processes are investigated with teaching experiments [8–10] and questionnaires. Results of the pilot study are used to redesign the learning environment.

The interactive poster presents the core experiments of the 3D-lab and first results of the teaching experiments.

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